PATENT ABSTRACTS OF JAPAN

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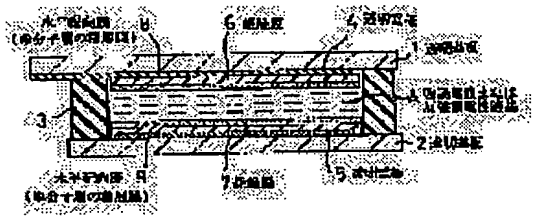
(54) LIQUID CRYSTAL ELEMENT

(57)Abstract:

PURPOSE: To improve the memory characteristic of the arranged state of liquid crystal molecules and to obtain a good display free from 'flickering' by forming horizontally oriented films by a Langmuir-Blodgett technique, thereby providing the horizontally oriented films with the orientation regulating power suitable for a ferroelectric or antiferroelectric liquid crystal.

CONSTITUTION: The surfaces facing each other of a pair of transparent substrates 1, 2 consisting of glass, etc., are provided respectively with transparent electrodes 4, 5. The electrode forming surfaces of these two substrates 1, 2 are covered by transparent insulating films 6, 7 consisting of silicon oxide, etc. These insulating films 6, 7 are provided thereon with horizontally oriented films 8, 9 for horizontally orienting the liquid crystal molecules of the ferroelectric liquid crystal A. The horizontally oriented films 8, 9 are both formed of laminated films of the monomolecular films deposited on the substrates 1, 2 by the Langmuir-Blodgett technique. The horizontally oriented films 8, 9 are polyimide films formed by imidizing films laminated with monomolecular layers of compd. constituted by bringing polyamic acid and long-chain alkyl amine to reaction into plural layers.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The liquid crystal device characterized by forming said level orientation film by the Langmuir-Blodgett's technique in the liquid crystal device which enclosed a ferroelectricity or antiferroelectricity liquid crystal between the transparence substrates of the couple which prepared a transparent electrode and the level orientation film.
[Claim 2] The level orientation film is a liquid crystal device according to claim 1 characterized by being the polyimide film which imide-ized the film which carried out the laminating of the monomolecular film of the compound to which polyamic acid and long-chain alkylamine are made to come to react to two or more layers.
[Claim 3] The level orientation film is a liquid crystal device according to claim 1 characterized by being the film which carried out the laminating of the monomolecular film of the compound to which polyamic acid and long-chain alkylamine are made to come to react to two or more layers.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the liquid crystal device which used a ferroelectricity or antiferroelectricity liquid crystal.
[0002]
[Description of the Prior Art] Recently, the ferroelectric liquid crystal component using a ferroelectricity or antiferroelectricity liquid crystal attracts attention. This ferroelectric liquid crystal component is what enclosed a ferroelectricity or antiferroelectricity liquid crystal between the transparence substrates of the couple which prepared a transparent electrode and the level orientation film, and it is used for the that optical incidence and outgoing radiation side for the polarizing plate of a couple by it, arranging.
[0003] This ferroelectric liquid crystal component is a thing using the memory nature of the molecular arrangement condition which a ferroelectricity or antiferroelectricity liquid crystal has, as for a ferroelectricity or antiferroelectricity liquid crystal, the smectic layer system is made, and the array direction of a liquid crystal molecule changes according to electric field with two or more stability of a molecular arrangement condition.
[0004] namely, a ferroelectric liquid crystal — the stability (bistability nature) of two molecular arrangement conditions — **** — the condition is maintained, even after arranging in the direction to which all the liquid crystal molecules inclined with the tilt angle which is in an one direction to the normal of a smectic layer system uniformly and refusing impression of electric field to it, when it gets down and one polar electric field are impressed. Moreover, the condition is maintained, even after arranging in the direction to which only the tilt angle which has all liquid crystal molecules in hard flow to said normal inclined uniformly and refusing impression of electric field to it, when the electric field of reversed polarity are impressed.
[0005] Moreover, antiferroelectricity liquid crystal has the stability of three molecular arrangement conditions. That 1st stable state is in a condition when one polar electric field are impressed, and at this time, even after it arranges it in the direction to which all the liquid crystal molecules inclined with the tilt angle which is in an one direction to the normal of a smectic layer system uniformly and it refuses impression of electric field to it, it maintains that condition. The 2nd stable state is in a condition when the electric field of reversed polarity are impressed, and at this time, even after it arranges it in the direction to which all the liquid crystal molecules inclined with the tilt angle which is in hard flow to said normal uniformly and it refuses impression of electric field to it, it maintains that condition. Moreover, the 3rd stable state is in a condition when the time of non-electric field or weak electric field is impressed, and a liquid crystal molecule arranges it to the reverse sense by turns with the same tilt angle to the normal of a smectic layer system in this condition (it arranges with the alternate sense for each class). There is the average array direction of the liquid crystal molecule in the whole liquid crystal layer in this 3rd stable state in the direction of a normal of a smectic layer system.
[0006] And if a ferroelectricity or antiferroelectricity liquid crystal is enclosed between the transparence substrates of the couple which prepared a transparent electrode and the level orientation film, since the direction of the normal of the smectic layer system will be regulated by the orientation processing

direction of the level orientation film of both substrates, The orientation processing direction of these orientation film is mutually made mostly parallel (it is the same or the sense of orientation processing is reverse sense). If the polarization shaft (a transparency shaft or absorption shaft) of the polarizing plate of the couple arranged to an optical incidence [of a liquid crystal device] and outgoing radiation side is set up according to said orientation processing direction, it can display by controlling transparency cutoff of light by changing the array condition of a liquid crystal molecule by impression of electric field.
[0007] By the way, conventionally, the level orientation film prepared in both the substrates of the above-mentioned ferroelectric liquid crystal component forms organic high molecular compound film, such as polyimide, on a substrate, it carries out rubbing processing and the film surface is formed in the one direction.
[0008]
[Problem(s) to be Solved by the Invention] however, the problem that the conventional ferroelectric liquid crystal component which forms in both substrates the level orientation film which carried out rubbing processing of the organic high molecular compound film, such as polyimide, has the weak memory nature (holdout of the array condition after refusing impression of electric field) of the array condition of a liquid crystal molecule, therefore "a flicker" occurs in a display — **** — it was.
[0009] If the level orientation film with which this carried out rubbing processing of the organic high molecular compound film, such as polyimide, is because the orientation restraining force is too strong and the orientation restraining force of the orientation film is too strong The liquid crystal molecule arranged in the direction to which it inclined with a certain tilt angle to the normal of a smectic layer system by impression of electric field It pulls back by the orientation restraining force of the orientation film, and in order to return to an initial array condition (antiferroelectricity liquid crystal the 3rd stable state) when the array condition of a liquid crystal molecule is not impressing electric field, the array condition of a liquid crystal molecule changes and "a flicker" is generated in a display.
[0010] The object of this invention gives the orientation restraining force suitable for a ferroelectricity or antiferroelectricity liquid crystal to the level orientation film, improves memory nature of the array condition of a liquid crystal molecule, and is to offer the ferroelectric liquid crystal component which can obtain the good display without "a flicker."
[0011]
[Means for Solving the Problem] This invention is characterized by forming said level orientation film by the Langmuir-Blodgett's technique in the liquid crystal device which enclosed a ferroelectricity or antiferroelectricity liquid crystal between the transparence substrates of the couple which prepared a transparent electrode and the level orientation film.
[0012] The above-mentioned level orientation film is film which carried out the laminating of the monomolecular film of the compound to which polyamic acid and long-chain alkylamine are made to come to react to two or more layers. This level orientation film Even if it is the polyimide film which imide-ized two or more layers of the monomolecular film of the compound to which said polyamic acid and long-chain alkylamine are made to come to react Moreover, you may be the non-imide-ized film which carried out the laminating of the monomolecular film of the compound to which said polyamic acid and long-chain alkylamine are made to come to react to two or more layers.
[0013]
[Function] the stacking tendency to which the level orientation film which consists of a cascade screen of the monomolecular film made to put on a substrate by the above-mentioned Langmuir-Blodgett's technique makes an one direction carry out level orientation of the liquid crystal molecule — **** — orientation restraining force [as opposed to / get down and / a ferroelectricity or antiferroelectricity liquid crystal] is weaker than the level orientation film which appeared in regulating the direction of the normal of a smectic layer system enough, and carried out rubbing processing of the organic high molecular compound film, such as conventional polyimide. That is, this orientation film has the orientation restraining force suitable for the ferroelectricity or antiferroelectricity liquid crystal which does not affect a ferroelectricity or the stability of the molecular arrangement condition of

antiferroelectricity liquid crystal. For this reason, since the liquid crystal molecule arranged in the direction to which it inclined with a certain tilt angle to the normal of a smectic layer system by impression of electric field is not pulled back by the orientation restraining force of the orientation film, therefore the array condition of a liquid crystal molecule does not change, the memory nature of the array condition of a liquid crystal molecule becomes good, and "a flicker" of a display of the ferroelectric liquid crystal component of this invention is lost.

[0014]

[Example] Hereafter, the example of this invention is explained with reference to drawing 1 and drawing 2.

[0015] Drawing 1 is the sectional view of a ferroelectric liquid crystal component. This ferroelectric liquid crystal component joins the transparence substrates 1 and 2 of a couple which consist of glass etc. through the frame-like sealant 3, it is what enclosed a ferroelectric liquid crystal or the antiferroelectricity liquid crystal A with both this substrate 1 and the field surrounded by the sealant 3 between two, and transparent electrodes 4 and 5 are formed in the field where both the above-mentioned substrates 1 and 2 counter mutually, respectively. Moreover, the electrode forming face of both these substrates 1 and 2 is covered by the transparent insulator layers 6 and 7 which consist of oxidation silicon (Si O2) etc., and the level orientation film 8 and 9 for carrying out orientation of the liquid crystal molecule of said ferroelectric liquid crystal A horizontally is formed on these insulator layers 6 and 7. In addition, this liquid crystal device is the thing of a simple matrix type, and the electrode 5 which formed in the scan electrode and the substrate 2 of another side the electrode 4 formed in one substrate 1 is a signal electrode.

[0016] The level orientation film 8 and 9 prepared in both the above-mentioned substrates 1 and 2 is formed by each by the cascade screen of the monomolecular film made to put on a substrate 1 and 2 by the Langmuir-Blodgett's technique.

[0017] the approach of making put the monomolecular film on the water surface on a substrate with a pull-up with constant speed, and going the substrate which the above-mentioned Langmuir-Blodgett's technique (the following and LB -- it is called law) made the monomolecular film on the potentiometric surface, and was made beforehand immersed at right angles to underwater -- it is -- this LB -- the stacking tendency to which the orientation film 8 and 9 which consists of a cascade screen of the monomolecular film made to put on a substrate 1 and 2 by law makes an one direction carry out level orientation of the liquid-crystal molecule -- **** -- it is.

[0018] And the ferroelectricity of these orientation film 8 and 9 or the orientation restraining force over the antiferroelectricity liquid crystal A is weaker than the level orientation film which fully for regulating the direction of the normal of a smectic layer system carried out rubbing processing of the organic high molecular compound film, such as conventional polyimide. That is, these orientation film 8 and 9 has the orientation restraining force suitable for the ferroelectricity or the antiferroelectricity liquid crystal A which does not affect a ferroelectricity or the stability of the molecular arrangement condition of the antiferroelectricity liquid crystal A.

[0019] For this reason, since the liquid crystal molecule arranged in the direction to which it inclined with a certain tilt angle to the normal of a smectic layer system by impression of electric field is not pulled back by the orientation restraining force of the orientation film 8 and 9, therefore the array condition of a liquid crystal molecule does not change, the memory nature of the array condition of a liquid crystal molecule becomes good, and "a flicker" of a display of the above-mentioned ferroelectric liquid crystal component is lost. Next, the concrete example of this invention is explained.

(The 1st example)

[0020] In this 1st example, it considered as the polyimide film which imide-ized the film which carried out the laminating of the monomolecular film of the compound to which polyamic acid and long-chain alkylamine are made to come for the above-mentioned level orientation film 8 and 9 to react to two or more layers (for example, 5-6 layers).

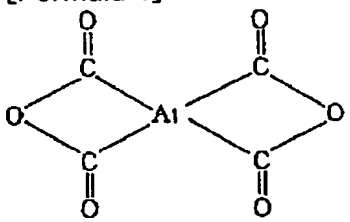
[0021] The above-mentioned level orientation film 8 and 9 is formed by the following approaches. In

addition, although formation of the level orientation film 8 prepared in one substrate 1 is explained, the level orientation film 9 prepared in the substrate 2 of another side is formed similarly here.

[0022] The above-mentioned polyamic acid is expressed with the structure expression of the following [-izing 3], and this polyamic acid compounds the tetracarboxylic dianhydride expressed with the structure expression of [-izing 1], and the diamine expressed with the structure expression of [-izing 2], and is obtained.

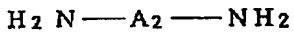
[0023]

[Formula 1]



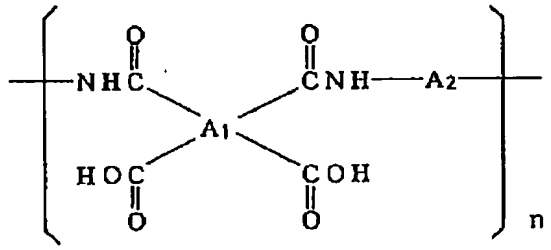
[0024]

[Formula 2]



[0025]

[Formula 3]

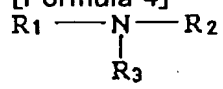


n は 1 以上の整数

[0026] Moreover, the above-mentioned long-chain alkylamine is for giving hydrophobicity to polyamic acid with a hydrophilic property, and this long-chain alkylamine is expressed with the structure expression of the next [-izing 4].

[0027]

[Formula 4]

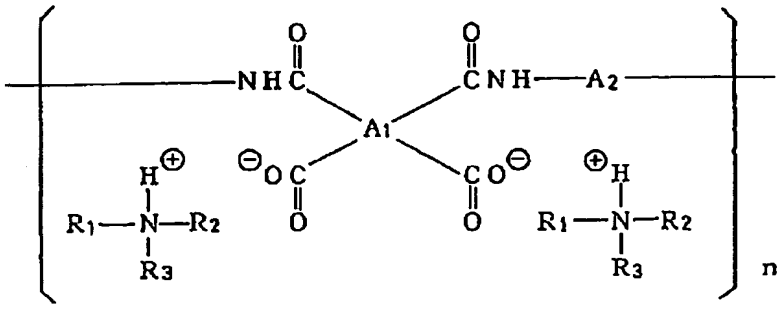


R_1 , R_2 は低級アルキル基または水素原子

R_3 は長鎖のアルキル基

[0028] The solution which melted the above-mentioned polyamic acid to the solvent, and the solution which melted the above-mentioned long-chain alkylamine to the same solvent are mixed at a rate of 1:1, the ionic bond reaction of the above-mentioned polyamic acid and the long-chain alkylamine is carried out, and the solution of the polyamic acid derivative compound (polyamic acid salt) expressed with the structure expression of the following [-izing 5] is created. In addition, as a solvent of the above-mentioned polyamic acid and long-chain alkylamine, the mixed solvent which mixed NMP (N-methyl-2-pyrrolidinone) and benzene at a rate of 1:1 is used. Moreover, the concentration of a long-chain alkylamine solution is the same as the concentration of a polyamic acid solution, or let it be concentration deeper than it.

[0029]
[Formula 5]



[0030] and the substrate 1 top which the level orientation film 8 formed the transparent electrode 4, and formed the insulator layer 6 on it — LB — carry out the laminating of the monomolecular film of the above-mentioned polyamic acid derivative compound to a necessary layer, and it is made to put on it by law, and the cascade screen of this monomolecular film is imide-ized by heat treatment, and is formed. drawing 2 — a substrate 1 top — the monomolecular film of a polyamic acid derivative compound — LB — how to make it covering by law is shown. Covering of this monomolecular film is performed as follows. First, hydrophilic processing is performed to the monomolecular-film covering side (the 6th page of insulator layer) of the above-mentioned substrate 1, and this substrate 1 is made immersed at right angles to underwater [in a cistern 10].

[0031] Next, after making the water surface in a cistern 10 into a potentiometric surface, the solution of the above-mentioned polyamic acid derivative compound is dropped on the water surface between the migration barrier 11 of the shape of a bar prepared in water surface height, and a substrate 1, and the monomolecular film a is developed on the water surface.

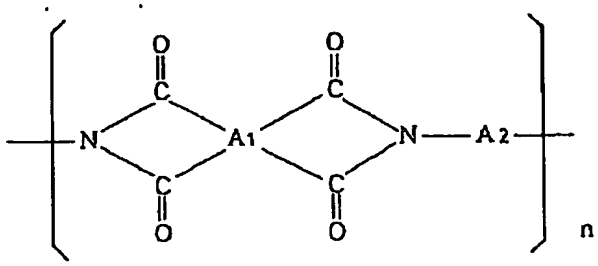
[0032] Next, moving the migration barrier 11 in the direction of a substrate with constant speed (2 mm/min), and pushing a monomolecular film a in the direction of a substrate, after moving the migration barrier 11 in the direction of a substrate, clustering the single molecule on the water surface and adjusting the surface pressure of a monomolecular film a to 1 constant pressure (25 dyn/cm), it is made to align with this, a substrate 1 is pulled up, and the monomolecular film a on the water surface is made to put on a substrate 1.

[0033] Since a part with a hydrophilic property adheres to the substrate 1 which has performed hydrophilic processing and the single molecule on the water surface can be pulled up at this time, a molecule puts a monomolecular film a on a substrate 1 in the condition of having stood in a line in the about 1 direction. The following repeats the covering process of the above-mentioned monomolecular film a, and carries out the laminating of the above-mentioned monomolecular film a to a necessary layer on a substrate 1.

[0034] Thus, heat treatment heated at an elevated temperature 300 degrees C or more for about 1 hour is performed, and let the cascade screen of said monomolecular film a be the polyimide film, after carrying out the laminating of the monomolecular film a of a polyamic acid derivative compound to a necessary layer on a substrate 1.

[0035] This polyimide film is what was imide-ized while polyamic acid and long-chain alkylamine remove the alkylamine of the polyamic acid derivative compound which is a compound which carried out ionic bond, and it has structure like the next [-izing 6].

[0036]
[Formula 6]



[0037] thus, the formed polyimide film — Above LB — the stacking tendency to which are the film in which the polyimide principal chain carried out orientation in the pull-up direction of the substrate 1 for covering of the monomolecular film a by law, and an one direction is made to carry out level orientation of the liquid crystal molecule — **** — since it is, even if it does not carry out rubbing processing of that film surface, this polyimide film can be used as the level orientation film 8 as it is.
[0038] namely, the monomolecular film a of the polyamic acid derivative compound with which this example makes polyamic acid and long-chain alkylamine come to react on the substrate 1 of the couple of a ferroelectric liquid crystal component, and 2 — LB — a laminating is carried out to two or more layers by law, and the cascade screen of this monomolecular film a is imide-ized by heat treatment, consider as the polyimide film, and let this polyimide film be the level orientation film 8 and 9.
[0039] thus, the orientation restraining force suitable for the ferroelectricity or the antiferroelectricity liquid crystal A which the formed level orientation film 8 and 9 appears in regulating the direction of the normal of a smectic layer system enough to a ferroelectricity or the antiferroelectricity liquid crystal A, and does not affect the stability of the array condition of a liquid crystal molecule — **** — it is.
[0040] For this reason, according to the ferroelectric liquid crystal component of the above-mentioned example, since the liquid crystal molecule arranged in the direction to which it inclined with a certain tilt angle to the normal of a smectic layer system by impression of electric field is pulled back by the orientation restraining force of the orientation film and that array condition does not change, memory nature of the array condition of a liquid crystal molecule can be improved, and the good display without "a flicker" can be obtained.
(The 2nd example) Next, the 2nd example of this invention is explained.
[0041] The compound to which the long-chain alkylamine expressed with the structure expression of the polyamic acid and the above [-izing 4] which are expressed with the structure expression of the above [-izing 3] is made to come to react in this 2nd example, That is, the monomolecular film of the polyamic acid derivative compound expressed with the structure expression of the above [-izing 5] A laminating is carried out to two or more layers (for example, 5-6 layers) on a substrate 1 and 2 by the LB method mentioned above. The cascade screen of this monomolecular film was dried at the temperature which does not make this imide-ize, the solvent (mixed solvent of NMP and benzene) of the above-mentioned polyamic acid and long-chain alkylamine was evaporated, and the film which remained on the substrate 1 was used as the level orientation film 8 and 9.
[0042] In addition, it sets in the structure expression of the above [-izing 5], and the stacking tendency of the orientation film which comes to carry out the laminating of the monomolecular film of the above-mentioned polyamic acid derivative compound is R3. It changes with carbon numbers of the expressed long-chain alkyl group, for example, is said R3. The monomolecular film with which a carbon number consists of a polyamic acid derivative compound of 18 shows a vertical stacking tendency, and is said R3. The monomolecular film with which a carbon number consists of a polyamic acid derivative compound of 14 shows a level stacking tendency.
[0043] So, at this example, it is said R3 as a polyamic acid derivative compound. The carbon number used the polyamic acid derivative compound of 14. this polyamic acid derivative compound — LB — the stacking tendency to which itself makes an one direction, as for a substrate 1 and the monomolecular film made to put on two, carry out level orientation of the liquid crystal molecule by law — **** — since it is, the cascade screen of this monomolecular film can be used as the level orientation film 8 and 9, without imide-izing this.

[0044] namely, the monomolecular film of the polyamic acid derivative compound with which this example makes polyamic acid and long-chain alkylamine come to react on the substrate 1 of the couple of a ferroelectric liquid crystal component, and 2 — LB — by law, carry out a laminating to two or more layers, and let the cascade screens of this monomolecular film be the level orientation film 8 and 9.
[0045] thus, the orientation restraining force suitable for the ferroelectricity or the antiferroelectricity liquid crystal A which the formed level orientation film 8 and 9 appears in regulating the direction of the normal of a smectic layer system enough to a ferroelectricity or the antiferroelectricity liquid crystal A, and does not affect the stability of the array condition of a liquid crystal molecule — **** — it is.
[0046] For this reason, also in the ferroelectric liquid crystal component of this example, the liquid crystal molecule arranged in the direction to which it inclined with a certain tilt angle to the normal of a smectic layer system by impression of electric field can be pulled back by the orientation restraining force of the orientation film, and that array condition cannot change, therefore memory nature of the array condition of a liquid crystal molecule can be improved, and the good display without "a flicker" can be obtained.
[0047] Moreover, the non-imide-ized film of only having carried out the laminating of the monomolecular film of the compound to which the polyamic acid used as the level orientation film 8 and 9 in this example and long-chain alkylamine are made to come to react to two or more layers Since the long-chain alkyl group is included, compared with the imide-ized orientation film (polyimide film) used as the level orientation film 8 and 9 in the 1st example of the above, surface tension and a polar force component are small, therefore can improve further memory nature of the array condition of a liquid crystal molecule.
[0048]
[Effect of the Invention] the level orientation film which is prepared in both the substrate according to the liquid crystal device of this invention — LB — since it forms by law, the orientation restraining force suitable for a ferroelectricity or antiferroelectricity liquid crystal can be given to the level orientation film, memory nature of the array condition of a liquid crystal molecule can be improved, and the good display without "a flicker" can be obtained.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view of a ferroelectric liquid crystal component showing one example of this invention.
[Drawing 2] Drawing showing how to make a monomolecular film put on a substrate.
[Description of Notations]
1 2 -- Transparence substrate
4 5 -- Transparent electrode
6 7 -- Insulator layer
8 Nine -- Level orientation film (cascade screen of a monomolecular film)
A -- A ferroelectricity or antiferroelectricity liquid crystal

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[Translation done.]

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	525	9225-2K		
C08G 73/10	NTF	9285-4J		

審査請求　未請求　請求項の数３　（全６頁）

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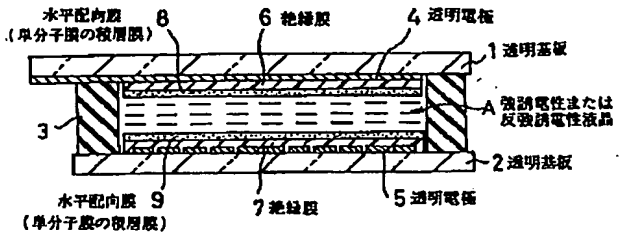
(54)【発明の名称】液晶素子

(57)【要約】
【目的】水平配向膜に強誘電性または反強誘電性液晶に適した配向規制力をもたせて液晶分子の配列状態のメモリ性を良くし、“ちらつき”のない良好な表示を得る。
【構成】水平配向膜８，９を、ＬＢ法により基板１，２上に被着させた単分子膜で形成した。



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【特許請求の範囲】

【請求項１】透明電極と水平配向膜とを設けた一対の透明基板間に強誘電性または反強誘電性液晶を封入した液晶素子において、前記水平配向膜を、ラングミュア・ブロジェット法により形成したことを特徴とする液晶素子。

【請求項２】水平配向膜は、ポリアミック酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜を複数層に積層した膜をイミド化したポリイミド膜であることを特徴とする請求項１に記載の液晶素子。

【請求項３】水平配向膜は、ポリアミック酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜を複数層に積層した膜であることを特徴とする請求項１に記載の液晶素子。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、強誘電性または反強誘電性液晶を用いた液晶素子に関するものである。

【０００２】

【従来の技術】最近、強誘電性または反強誘電性液晶を用いた強誘電性液晶素子が注目されている。この強誘電性液晶素子は、透明電極と水平配向膜とを設けた一対の透明基板間に強誘電性または反強誘電性液晶を封入したもので、その光入射側と出射側とに一対の偏光板を配置して使用されている。

【０００３】この強誘電性液晶素子は、強誘電性または反強誘電性液晶がもっている分子配列状態のメモリ性を利用したもので、強誘電性または反強誘電性液晶はスメクティック層構造をなしており、分子配列状態の複数の安定性をもちかつ電界に応じて液晶分子の配列方向が変化する。

【０００４】すなわち、強誘電性液晶は、２つの分子配列状態の安定性（双安定性）をもっており、一方の極性の電界が印加されたときは全ての液晶分子がスメクティック層構造の法線に対し一方向にあるチルト角で傾いた方向に一様に配列し、電界の印加を断った後もその状態を保つ。また、逆極性の電界が印加されたときは全ての液晶分子が前記法線に対し逆方向にあるチルト角だけ傾いた方向に一様に配列し、電界の印加を断った後もその状態を保つ。

【０００５】また、反強誘電性液晶は、３つの分子配列状態の安定性をもっている。その第１の安定状態は、一方の極性の電界が印加されたときの状態であり、このときは、全ての液晶分子がスメクティック層構造の法線に対し一方向にあるチルト角で傾いた方向に一様に配列し、電界の印加を断った後もその状態を保つ。第２の安定状態は、逆極性の電界が印加されたときの状態であり、このときは、全ての液晶分子が前記法線に対し逆方向にあるチルト角で傾いた方向に一様に配列し、電界の印加を断った後もその状態を保つ。また、第３の安定状態は、無電界時または弱い電界が印加されたときの状態であり、この状態では、液晶分子がスメクティック層構造の法線に対し同じチルト角で交互に逆向きに配列（各層ごとに互い違いの向きで配列）する。この第３の安定状態における液晶層全体での液晶分子の平均的な配列方向はスメクティック層構造の法線方向にある。

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【０００６】そして、透明電極と水平配向膜とを設けた一対の透明基板間に強誘電性または反強誘電性液晶を封入すると、そのスメクティック層構造の法線の方向が両基板の水平配向膜の配向処理方向によって規制されるため、これら配向膜の配向処理方向を互いにほぼ平行（配向処理の向きは同じかまたは逆向き）にし、液晶素子の光入射側と出射側とに配置する一対の偏光板の偏光軸（透過軸または吸収軸）を前記配向処理方向に応じて設定しておけば、電界の印加により液晶分子の配列状態を変えてやることによって光の透過遮断を制御して、表示を行なうことができる。

【０００７】ところで、上記強誘電性液晶素子の両基板に設けられる水平配向膜は、従来、基板上にポリイミド等の有機高分子化合物膜を形成し、その膜面を一方向にラビング処理して形成されている。

【０００８】

【発明が解決しようとする課題】しかしながら、両基板にポリイミド等の有機高分子化合物膜をラビング処理した水平配向膜を形成している従来の強誘電性液晶素子は、液晶分子の配列状態のメモリ性（電界の印加を断った後の配列状態の保持性）が弱く、したがって表示に“ちらつき”が発生するという問題をもっていた。

【０００９】これは、ポリイミド等の有機高分子化合物膜をラビング処理した水平配向膜はその配向規制力が強すぎるためであり、配向膜の配向規制力が強すぎると、電界の印加によりスメクティック層構造の法線に対しあるチルト角で傾いた方向に配列した液晶分子が、配向膜の配向規制力で引き戻されて、液晶分子の配列状態が電界を印加していないときの初期配列状態（反強誘電性液晶では第３の安定状態）に戻ろうとするため、液晶分子の配列状態が変化して、表示に“ちらつき”を発生する。

【００１０】本発明の目的は、水平配向膜に強誘電性または反強誘電性液晶に適した配向規制力をもたせて液晶分子の配列状態のメモリ性を良くし、“ちらつき”のない良好な表示を得ることができる強誘電性液晶素子を提供することにある。

【００１１】

【課題を解決するための手段】本発明は、透明電極と水平配向膜とを設けた一対の透明基板間に強誘電性または反強誘電性液晶を封入した液晶素子において、前記水平配向膜を、ラングミュア・ブロジェット法により形成したことを特徴とするものである。

【００１２】上記水平配向膜は、例えば、ポリアミック

酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜を複数層に積層した膜であり、この水平配向膜は、前記ポリアミック酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜の複数層をイミド化したポリイミド膜であっても、また、前記ポリアミック酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜を複数層に積層した非イミド化膜であってもよい。

【００１３】

【作用】上記ラングミュア・ブロジェット法により基板上に被着させた単分子膜の積層膜からなる水平配向膜は、液晶分子を一方向に水平配向させる配向性をもっており、強誘電性または反強誘電性液晶に対する配向規制力は、スメクティック層構造の法線の方向を規制するのに十分で、かつ、従来のポリイミド等の有機高分子化合物膜をラビング処理した水平配向膜よりは弱い。すなわち、この配向膜は、強誘電性または反強誘電性液晶の分子配列状態の安定性に影響を及ぼすことのない、強誘電性または反強誘電性液晶に適した配向規制力をもっている。このため、本発明の強誘電性液晶素子は、電界の印加によりスメクティック層構造の法線に対しあるチルト角で傾いた方向に配列した液晶分子が配向膜の配向規制力で引き戻されることはなく、したがって液晶分子の配列状態が変化することはないから、液晶分子の配列状態のメモリ性が良くなり、表示の“ちらつき”がなくなる。

【００１４】

【実施例】以下、本発明の実施例を図１および図２を参照して説明する。

【００１５】図１は強誘電性液晶素子の断面図である。この強誘電性液晶素子は、ガラス等からなる一対の透明基板１，２を枠状のシール材３を介して接合し、この両基板１，２間のシール材３で囲まれた領域に、強誘電性液晶または反強誘電性液晶Ａを封入したもので、上記両基板１，２の互いに対向する面にはそれぞれ、透明電極４，５が設けられている。また、この両基板１，２の電極形成面は、酸化硅素（SiO_2）等からなる透明な絶縁膜６，７で覆われており、この絶縁膜６，７の上に、前記強誘電性液晶Ａの液晶分子を水平方向に配向させるための水平配向膜８，９が設けられている。なお、この液晶素子は、単純マトリックス型のものであり、一方の基板１に形成した電極４は走査電極、他方の基板２に形成した電極５は信号電極である。

【００１６】上記両基板１，２に設けた水平配向膜８，９は、いずれも、ラングミュア・ブロジェット法により基板１，２上に被着させた単分子膜の積層膜で形成されている。

【００１７】上記ラングミュア・ブロジェット法（以下、ＬＢ法という）は、静水面上に単分子膜を作り、あらかじめ水中に垂直に浸漬させておいた基板を一定速度で引上げながら、水面上の単分子膜を基板上に被着させて行く方法であり、このＬＢ法により基板１，２上に被着させた単分子膜の積層膜からなる配向膜８，９は、液晶分子を一方向に水平配向させる配向性をもっている。

【００１８】そして、この配向膜８，９の強誘電性または反強誘電性液晶Ａに対する配向規制力は、スメクティック層構造の法線の方向を規制するのに十分で、かつ、従来のポリイミド等の有機高分子化合物膜をラビング処理した水平配向膜よりは弱い。すなわち、この配向膜８，９は、強誘電性または反強誘電性液晶Ａの分子配列状態の安定性に影響を及ぼすことのない、強誘電性または反強誘電性液晶Ａに適した配向規制力をもっている。

【００１９】このため、上記強誘電性液晶素子は、電界の印加によりスメクティック層構造の法線に対しあるチルト角で傾いた方向に配列した液晶分子が配向膜８，９の配向規制力で引き戻されることはなく、したがって液晶分子の配列状態が変化することはないから、液晶分子の配列状態のメモリ性が良くなり、表示の“ちらつき”がなくなる。次に、本発明の具体的な実施例を説明する。

（第１の実施例）

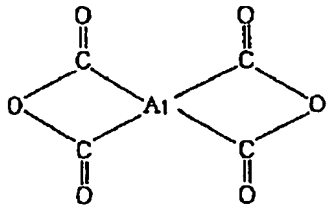
【００２０】この第１の実施例では、上記水平配向膜８，９を、ポリアミック酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜を複数層（例えば５～６層）に積層した膜をイミド化したポリイミド膜とした。

【００２１】上記水平配向膜８，９は、次のような方法で形成する。なお、ここでは、一方の基板１に設ける水平配向膜８の形成について説明するが、他方の基板２に設ける水平配向膜９も同様にして形成する。

【００２２】上記ポリアミック酸は、下記の［化３］の構造式で表わされ、このポリアミック酸は、［化１］の構造式で表わされるテトラカルボン酸二無水物と、［化２］の構造式で表わされるジアミンとを合成して得られる。

【００２３】

【化１】



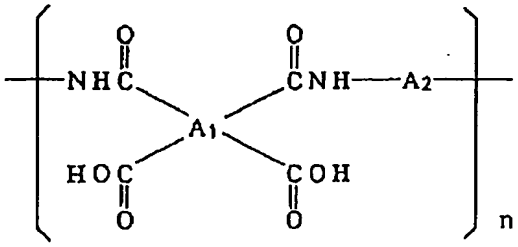
【００２４】

【化２】

$$H_2N-A_2-NH_2$$

【００２５】

【化３】

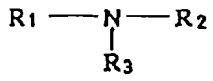


nは１以上の整数

【００２６】また、上記長鎖アルキルアミンは、親水性をもつポリアミック酸に疎水性を付与するためのものであり、この長鎖アルキルアミンは次の［化４］の構造式で表わされる。

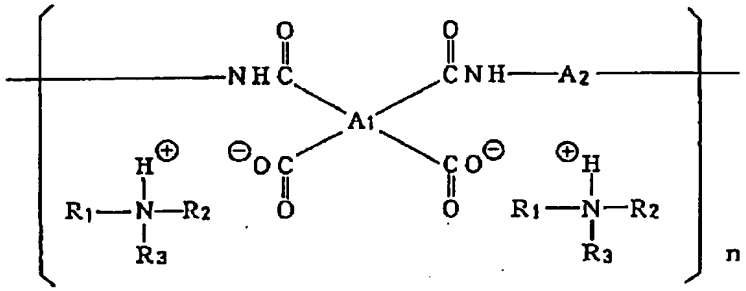
【００２７】

【化４】



R1，R2は低級アルキル基または水素原子

R3は長鎖のアルキル基



【００２８】上記ポリアミック酸を溶媒に溶かした溶液と、上記長鎖アルキルアミンを同じ溶媒に溶かした溶液とを１：１の割合で混合し、上記ポリアミック酸と長鎖アルキルアミンとをイオン結合反応させて、下記の［化５］の構造式で表わされるポリアミック酸誘導体化合物（ポリアミック酸塩）の溶液を作成する。なお、上記ポリアミック酸および長鎖アルキルアミンの溶媒としては、ＮＭＰ（Ｎ－メチル－２－ピロリジノン）とベンゼンを１：１の割合で混合した混合溶媒を用いる。また、長鎖アルキルアミン溶液の濃度は、ポリアミック酸溶液の濃度と同じか、あるいはそれより濃い濃度とする。

【００２９】

【化５】

【００３０】そして、水平配向膜８は、透明電極４を形成しその上に絶縁膜６を形成した基板１上に、ＬＢ法によって上記ポリアミック酸誘導体化合物の単分子膜を所要層に積層して被着させ、この単分子膜の積層膜を、熱処理によりイミド化して形成する。図２は、基板１上にポリアミック酸誘導体化合物の単分子膜をＬＢ法によって被着させる方法を示している。この単分子膜の被着は次のようにして行なう。まず、上記基板１の単分子膜被着面（絶縁膜６面）に親水性処理を施し、この基板１を水槽１０内の水中に垂直に浸漬させる。

【００３１】次に、水槽１０内の水面を静水面とした後、水面高さに設けたバー状の移動バリア１１と基板１との間の水面上に上記ポリアミック酸誘導体化合物の溶液を滴下して、その単分子膜ａを水面上に展開させる。

【００３２】次に、移動バリア１１を基板方向に移動させて水面上の単分子を密集させ、単分子膜ａの表面圧を一定圧（２５dyn/cm）に調整した後、移動バリア１１を基板方向に一定速度（２mm/min）で移動させて単分子膜ａを基板方向に押しながら、これに同調させて基板１を引上げて、水面上の単分子膜ａを基板１上に被着させる。

【００３３】このとき、水面上の単分子は、親水性をもつ部分が親水性処理を施してある基板１に付着して引上げられるため、単分子膜ａは、分子がほぼ一方向に並んだ状態で基板１上に被着する。以下は、上記単分子膜ａの被着工程を繰返して、基板１上に上記単分子膜ａを所要層に積層する。

【００３４】このようにして基板１上にポリアミック酸誘導体化合物の単分子膜ａを所要層に積層した後は、３００℃以上の高温で約１時間加熱する熱処理を行なって前記単分子膜ａの積層膜をポリイミド膜とする。

【００３５】このポリイミド膜は、ポリアミック酸と長鎖アルキルアミンとがイオン結合した化合物であるポリアミック酸誘導体化合物のアルキルアミンを除去するとともにイミド化したもので、次の［化６］のような構造をもっている。

【００３６】

【化６】

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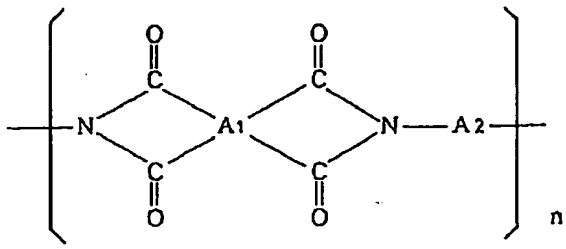

【００３７】このようにして形成されたポリイミド膜は、上記ＬＢ法による単分子膜ａの被着に際しての基板１の引上げ方向にポリイミド主鎖が配向した膜であり、液晶分子を一方向に水平配向させる配向性をもっているため、その膜面をラビング処理しなくても、このポリイミド膜をそのまま水平配向膜８とすることができる。

【００３８】すなわち、この実施例は、強誘電性液晶素子の一対の基板１，２上に、ポリアミック酸と長鎖アルキルアミンとを反応させてなるポリアミック酸誘導体化合物の単分子膜ａをＬＢ法によって複数層に積層し、この単分子膜ａの積層膜を熱処理によりイミド化してポリイミド膜とし、このポリイミド膜を水平配向膜８，９としたものである。

【００３９】このようにして形成した水平配向膜８，９は、強誘電性または反強誘電性液晶Ａに対して、スメクティック層構造の法線の方向を規制するのに十分で、かつ、液晶分子の配列状態の安定性に影響を及ぼすことのない、強誘電性または反強誘電性液晶Ａに適した配向規制力をもっている。

【００４０】このため、上記実施例の強誘電性液晶素子によれば、電界の印加によりスメクティック層構造の法線に対しあるチルト角で傾いた方向に配列した液晶分子が配向膜の配向規制力で引き戻されてその配列状態が変化することはないから、液晶分子の配列状態のメモリ性を良くして、“ちらつき”のない良好な表示を得ることができる。

（第２の実施例）次に、本発明の第２の実施例を説明する。

【００４１】この第２の実施例では、上記［化３］の構造式で表されるポリアミック酸と上記［化４］の構造式で表される長鎖アルキルアミンとを反応させてなる化合物、つまり上記［化５］の構造式で表されるポリアミック酸誘導体化合物の単分子膜を、上述したＬＢ法によって基板１，２上に複数層（例えば５～６層）に積層し、この単分子膜の積層膜を、これをイミド化させない温度で乾燥させて上記ポリアミック酸および長鎖アルキルアミンの溶媒（ＮＭＰとベンゼンの混合溶媒）を蒸発させ、基板１上に残った膜を水平配向膜８，９とした。

【００４２】なお、上記ポリアミック酸誘導体化合物の単分子膜を積層してなる配向膜の配向性は、上記［化５］の構造式においてR₁で表した長鎖のアルキル基の炭素数によって異なり、例えば前記R₁の炭素数が１８のポリアミック酸誘導体化合物からなる単分子膜は垂直

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配向性を示し、前記R₁の炭素数が１４のポリアミック酸誘導体化合物からなる単分子膜は水平配向性を示す。

【００４３】そこで、この実施例では、ポリアミック酸誘導体化合物として、前記R₁の炭素数が１４のポリアミック酸誘導体化合物を用いた。このポリアミック酸誘導体化合物をＬＢ法によって基板１，２上に被着させた単分子膜は、それ自体が液晶分子を一方向に水平配向させる配向性をもっているため、この単分子膜の積層膜は、これをイミド化することなく水平配向膜８，９とすることができる。

【００４４】すなわち、この実施例は、強誘電性液晶素子の一対の基板１，２上に、ポリアミック酸と長鎖アルキルアミンとを反応させてなるポリアミック酸誘導体化合物の単分子膜をＬＢ法によって複数層に積層し、この単分子膜の積層膜を水平配向膜８，９としたものである。

【００４５】このようにして形成した水平配向膜８，９は、強誘電性または反強誘電性液晶Ａに対して、スメクティック層構造の法線の方向を規制するのに十分で、かつ、液晶分子の配列状態の安定性には影響を及ぼすことのない、強誘電性または反強誘電性液晶Ａに適した配向規制力をもっている。

【００４６】このため、この実施例の強誘電性液晶素子においても、電界の印加によりスメクティック層構造の法線に対しあるチルト角で傾いた方向に配列した液晶分子が配向膜の配向規制力で引き戻されてその配列状態が変化することはなく、したがって、液晶分子の配列状態のメモリ性を良くし、“ちらつき”のない良好な表示を得ることができる。

【００４７】また、この実施例において水平配向膜８，９としたポリアミック酸と長鎖アルキルアミンとを反応させてなる化合物の単分子膜を複数層に積層しただけの非イミド化膜は、長鎖のアルキル基を含んでいるため、上記第１の実施例において水平配向膜８，９としているイミド化配向膜（ポリイミド膜）に比べて、表面張力および極性力成分が小さく、したがって、液晶分子の配列状態のメモリ性をさらに良くすることができる。

【００４８】

【発明の効果】本発明の液晶素子によれば、その両基板に設ける水平配向膜を、ＬＢ法により形成しているため、水平配向膜に強誘電性または反強誘電性液晶に適した配向規制力をもたせて液晶分子の配列状態のメモリ性を良くし、“ちらつき”のない良好な表示を得ることができる。

【図面の簡単な説明】

【図１】本発明の一実施例を示す強誘電性液晶素子の断面図。

【図２】基板上に単分子膜を被着させる方法を示す図。

【符号の説明】

１，２…透明基板

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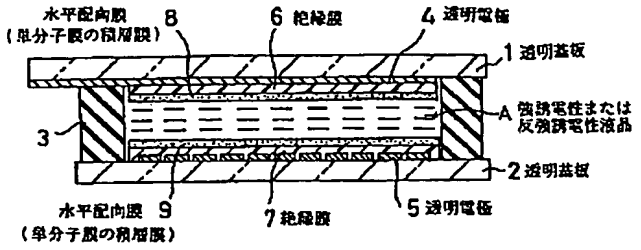
4，5…透明電極

6，7…絶縁膜

8，9…水平配向膜（単分子膜の積層膜）

A…強誘電性または反強誘電性液晶

【図１】



【図２】